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# NASA CONTRACTOR REPORT

NASA CR-61386

## SKYLAB EXPERIMENT PERFORMANCE EVALUATION MANUAL

### Appendix D: Experiment M487 Habitability/Crew Quarters (MSFC)

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January 1973

Prepared for

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Marshall Space Flight Center, Alabama 35812

1. REPORT NO. NASA CR-61386	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.	
4. TITLE AND SUBTITLE Skylab Experiment Performance Evaluation Manual. Appendix D: Experiment M487 Habitability/Crew Quarters (MSFC)		5. REPORT DATE January 1973	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) K. S. Purushotham		8. PERFORMING ORGANIZATION REPORT #	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Teledyne Brown Engineering Company Huntsville, Alabama		10. WORK UNIT NO.	11. CONTRACT OR GRANT NO. NAS8-21804
12. SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D. C. 20546		13. TYPE OF REPORT & PERIOD COVERED Contractor Report	
15. SUPPLEMENTARY NOTES Prepared for Astronautics Laboratory, Science and Engineering		14. SPONSORING AGENCY CODE	
16. ABSTRACT  This appendix contains a series of analyses for Experiment M487, Habitability/Crew Quarters (MSFC), to be used for evaluating the performance of the Skylab corollary experiments under preflight, inflight, and post-flight conditions. Experiment contingency plan workaround procedure and malfunction analyses are presented in order to assist in making the experiment operationally successful.			
17. KEY WORDS  Skylab Experiments		18. DISTRIBUTION STATEMENT  Unclassified - Unlimited  <i>William Ashew</i>	
19. SECURITY CLASSIF. (of this report) Unclassified	20. SECURITY CLASSIF. (of this page) Unclassified	21. NO. OF PAGES 49	22. PRICE NTIS

APPENDIX D.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS (MSFC).

Prepared By:

K. S. Purushotham

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## DEFINITION OF SYMBOLS

AM	Airlock Module
CM	Command Module
DAC	Data Acquisition Camera
FBD	Functional Block Diagram
FO	Functional Objective
M/C	Mixing Chamber
OWS	Orbital Workshop
PDCS	Power Distribution Control System
PI	Principal Investigator
$P_f$	Probability of failure
$P_{ft}$	Total probability of failure
$P_s$	Probability of success
TCS	Temperature Control System
VCS	Ventilation Control System

SECTION I.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
PRE-FLIGHT OPERATIONS EVALUATION ANALYSIS



TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 1 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER*	REMARKS
	MIN.	NOM.	MAX.		
3.0 Analyze and predict facet performance profile for Skylab Experiment M-487, Habitability/ Crew Quarters.				N/A	Refer to functional item 3.1.
3.1 Make explicit statements about objectives in qualitative and quantitative terms.				N/A	Refer to functional item 3.1.1.
3.1.1 Specify the time required for M-487 tasks to be performed.					Experiment M-487 is performed on SL-1/SL-2, SL-3, and SL-4 missions. M-487 will evaluate and report habitability features of the Orbital Workshop (OWS) and will assess the man-machine relationship under zero-g conditions in relatively confined areas. The experiment provides equipment necessary to measure the habitability features subjectively and objectively. The data collected will be used to evaluate OWS/crew interfaces and will form a basis for verifying habitability criteria and establishing requirements for future advanced spacecraft. To avoid impact on the mission timeline, the habitability data collection will be integrated into the crewman's daily routine.
3.1.2 Specify the types of criteria that are to be maximized or minimized.				N/A	Reference 1.  The Functional Objectives (FO's) of Experiment M-487 Habitability/Crew Quarters are:  • FO-1 --Obtain motion picture and objective and subjective data on the OWS internal architecture during Skylab missions.  • FO-2 --Obtain motion picture and objective and subjective data on the OWS internal architecture.  • FO-3 --Obtain motion picture and objective and subjective data on the adequacy of OWS mobility aids and restraints.  • FO-4 --Obtain motion picture and objective and subjective data on the use and adequacy of food and water.  • FO-5 --Obtain motion picture and objective and subjective data on garments and personal accouterments.

\*Criticality Category Number Definition:

- Category I--Experiment and equipment whose failure could adversely affect crew safety.
- Category II--Experiment and equipment whose failure could result in not achieving a primary mission objective, but does not adversely affect crew safety.
- Category IIIa--Experiment and equipment whose failure could result in not achieving a secondary mission objective, but which does not adversely affect crew safety or preclude the achievement of any primary mission objective.
- Category IIIb--Experiment and equipment whose failure could not result in a loss of primary or secondary mission objective and does not adversely affect crew safety.

TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS, PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 2 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.1.2 (Concluded)					<ul style="list-style-type: none"> <li>FO-6 --Obtain motion picture and objective and subjective data on personal hygiene.</li> <li>FO-7 --Obtain motion picture and objective and subjective data on OWS housekeeping tasks.</li> <li>FO-8 --Obtain motion picture and objective and subjective data on communication within the OWS.</li> <li>FO-9 --Obtain motion picture and subjective data on the adequacy of the OWS off-duty activity provisions.</li> </ul> <p>References 2, 3, and 4.</p> <p>It is subjectively estimated that the accomplishment of the following would provide a minimum acceptable amount of experiment data:</p> <ul style="list-style-type: none"> <li>FO-1: Obtain subjective data on OWS environment. This constitutes 50 percent of the total desired data of FO-1 or 50 percent x 15 percent = 7.5 percent of the total objective.</li> <li>FO-2: Obtain subjective data on the internal architecture. This constitutes 33 1/3 percent of the desired data of FO-2 or 33 1/3 percent x 10 percent = 3 1/3 percent of the total objective.</li> <li>FO-3: Obtain subjective data on the adequacy of OWS mobility aids and restraints. This constitutes 33 percent of the desired data or 33 1/3 percent x 10 percent = 33 1/3 percent of the total objective.</li> <li>FO-4: Obtain subjective data on the adequacy of food and water provisions. This constitutes 33 1/3 percent of the desired data of FO-4 or 33 1/3 percent x 10 percent = 3 1/3 percent of the total objective.</li> <li>FO-5: Obtain subjective data on garments and personal accouterments. This constitutes 33 1/3 percent of the desired data of FO-5, or 33 1/3 percent x 10 percent = 3 1/3 percent of the total objective.</li> <li>FO-6: Obtain subjective data on personal hygiene. This constitutes 33 1/3 percent of the desired data of FO-6, or 33 1/3 percent x 15 percent = 5 percent of the total objective.</li> </ul>
3.1.3 Specify the percentage of acceptable max. /min. for each objective.	7.5%	11.25%	15%	N/A	
	3.33%	6.66%	10%		
	3.33%	6.66%	10%		
	3.33%	6.66%	10%		
	3.33%	6.66%	10%		
	5%	10%	15%		

TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 3 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.1.3 (Concluded)	3.33%	6.66%	10%		<ul style="list-style-type: none"> <li>FO-7: Obtain subjective data on OWS housekeeping activities. This constitutes 33 1/3 percent of the desired data of FO-7 or 33 1/3 percent x 10 percent = 3 1/3 percent of the total objective.</li> <li>FO-8: Obtain subjective data on the OWS internal communications. This constitutes 33 1/3 percent of the desired data of FO-8, or 33 1/3 percent x 10 percent = 3 1/3 percent of the total objective.</li> <li>FO-9: Obtain subjective data on the adequacy of OWS off duty activity provisions. This constitutes 100 percent of the desired data of FO-8 or 100 percent x 10 percent = 10 percent of the total objective.</li> </ul> <p>Total percentage of acceptable max. /min.</p>
3.1.4 Specify the experiment constraints: <ul style="list-style-type: none"> <li>• Musts</li> <li>• Must Nots</li> <li>• Wants</li> <li>• Don't Wants.</li> </ul>				N/A	<ul style="list-style-type: none"> <li>Musts               <ul style="list-style-type: none"> <li>--Subjective crew comments concerning the habitability of the OWS must be recorded with respect to the following parameters:                   <ul style="list-style-type: none"> <li>-Dimensional characteristics of OWS systems equipment</li> <li>-Location and adequacy of mobility aids and restraints</li> <li>-Air: temperatures, velocities, and humidity</li> <li>-Touch temperatures of OWS systems equipment during handling operations</li> <li>-Adequacy of internal illumination</li> <li>-Internal noise level of the OWS</li> <li>-Adequacy and suitability of clothing</li> <li>-Presence of any obnoxious odors within the OWS</li> <li>-Adequacy of internal communications.</li> </ul> </li> <li>--Measurements of environmental features must be made with hardware, which includes measuring air velocity, sound level, and air or surface temperature. These measurements must be recorded by the crew and related to the crew comfort for the following OWS compartments:                   <ul style="list-style-type: none"> <li>-Sleeping</li> <li>-Wardroom</li> <li>-Waste Management</li> <li>-Experiment</li> <li>-Forward compartment.</li> </ul> </li> <li>--Motion pictures of various crew activities are required to aid in evaluation of crew/OWS interfaces. The motion picture will be taken with a 16mm Data Acquisition Camera (DAC) using 16 mm Ektachrome SO-168 color film (three cassettes will be provided, each containing 400 ft of film).</li> </ul> </li> <li>Must Nots               <ul style="list-style-type: none"> <li>--N/A</li> </ul> </li> </ul>

TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 4 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.1.4 (Concluded)					<ul style="list-style-type: none"> <li>• Wants</li> <li>--It is desirable to gather periodic measurements at an early point, at mid-point, and at a late point in the mission to establish trend data.</li> <li>• Don't Wants</li> <li>--N/A</li> </ul>
3.1.5 Specify the experiment operational tolerances: <ul style="list-style-type: none"> <li>• Musts</li> <li>• Must Not</li> <li>• Wants</li> <li>• Don't Wants.</li> </ul>				N/A	<p>References 1 and 5.</p> <p>Refer to functional item 3.1.4. Specific tolerances for each functional item are TBD.</p>
3.2 Define the decision rules for each experiment objective.				N/A	<p>If the experiment is aborted, the probability of success (<math>P_s</math>) is equal to 0.0. If the experiment is compromised and minimum information is salvaged, <math>P_s = 0.1 \rightarrow 0.5</math>; if the maximum information is salvaged, <math>P_s = 0.5 \rightarrow 0.9</math>. If the experiment is completed as scheduled, <math>P_s = 1.0</math>.</p>
3.3 Specify the experiment priority number (numerical statement) for a given Skylab flight designation.				N/A	<p>Experiment M-487 is scheduled for SL-1/SL-2, SL-3, and SL-4 missions. The priority number is 450.</p> <p>References 1 and 6.</p>
3.4 Briefly describe and list the major subsystems for Experiment M-487.				N/A	<p>Refer to functional items 3.4.1 and 3.4.2.</p>
3.4.1 Describe the major functions.					<p>Experiment M-487 is designed to measure, evaluate, and report habitability features of the crew quarters and work areas of the OWS in engineering terms useful to the design of future manned spacecraft.</p> <p>Experiment M-487 provides the crewman with procedures and equipment necessary to measure and record his observations, and to evaluate the following elements:</p>

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TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 5 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.4.1 (Concluded)					<ul style="list-style-type: none"> <li>• Personal Hygiene</li> <li>• Food and Water</li> <li>• Garment and Personal Accouterments</li> <li>• Architecture</li> <li>• Mobility and Restraints</li> <li>• Off-Duty Activities</li> <li>• Environment</li> <li>• Communications.</li> </ul>
3.4.2 List the major components.					<p>Reference 1.</p> <p>The major components involved in Experiment M-487 are:</p> <ul style="list-style-type: none"> <li>• Velometer</li> <li>• Sound Level Meter</li> <li>• Thermometers</li> <li>• Surface Temperature Sensor (Digital Thermometer)</li> <li>• Frequency Analyzer</li> <li>• Spring Scale</li> <li>• Measuring Tape</li> <li>• Spare Batteries.</li> </ul> <p>All of the above equipment is considered off-the-shelf hardware.</p> <p>References 1 and 7.</p> <p>A Functional Block Diagram (FBD) is submitted as Figure D-1 and is used as a subsystem component listing. Critical subsystems will be identified and evaluated for failure, and correlated to possible experiment/carrier interface problems.</p>
3.5 Define the M-487 experiment/ carrier subsystem interfaces:				N/A	<ul style="list-style-type: none"> <li>• Physical</li> <li>--Mechanical</li> <li>--Electrical</li> <li>--Communication and Data</li> <li>--Support</li> </ul>

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TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 6 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5 (Concluded) <ul style="list-style-type: none"> <li>• Environmental               <ul style="list-style-type: none"> <li>--Natural and Induced</li> <li>--Contamination</li> </ul> </li> <li>• Operational               <ul style="list-style-type: none"> <li>--Pointing and Control</li> <li>--Crew Safety</li> <li>--Sequence</li> <li>--Operability.</li> </ul> </li> </ul> 3.5.1 Specify the total probability of failure ( $P_{ft}$ ) for the velometer.		0.1		IIIb	<p>The velometer provides the means to measure air velocity within the OWS. The instrument has a metal probe attached to it, and can be installed in ducts, lines, pipes or be hand-held. This instrument operates on the principles of a thermocouple. The sensing elements in the probes are bi-metallic strips. A low voltage ac bridge circuit heats the bimetallic strips. Any change in airflow causes a change in temperature of the bimetallic strips, resulting in a low Vdc output from the thermocouples. These changes are indicated on the dial as changes in velocity. The range of this instrument is 0 to 100 rpm and it requires 3 Vdc to operate.</p> <p>The probability of failure (<math>P_f</math>) of the velometer is very small. If this should fail, the following situation could occur:</p> <ul style="list-style-type: none"> <li>• Electrical               <ul style="list-style-type: none"> <li>--The fine thermocouple element can break and result in loss of usage of the experiment.</li> </ul> </li> </ul> <p>The following indication could be used to determine the failure of the velometer:</p> <ul style="list-style-type: none"> <li>• Zero deflection of the velometer scale is an indication of a failure in the instrument.</li> <li>• Repeated measurement in the same location could be used to indicate any faulty operation of the instrument.</li> </ul> <p>Reference 7.</p> <p>The sound level meter is used to measure the intensity of workshop ambient, periodic, and random noises. The sound level meter is powered by three 1.5 Vdc flashlight batteries. The instrument consists of: condenser, microphone and source follower, input amplifier with input attenuator, weighting network, output amplifier with output attenuators, meter rectifier and indicating meter, and batteries. The meter scale is graduated <math>\pm 10</math> dB. The range is 32 to 140 dB within a frequency range of 50 to 10,000 Hz, and the accuracy is <math>\pm 2</math> dB up to 5,000 Hz and <math>\pm 5</math> dB up to 10,000 Hz. The instrument is operated by three batteries of 1.5 Vdc each.</p>
3.5.2 Specify the $P_{ft}$ for Sound Level Meter.		0.1		IIIb	

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TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 7 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5.2 (Concluded)					<p>The <math>P_f</math> for the sound level meter is very small. If this should fail, the following situation could occur:</p> <ul style="list-style-type: none"> <li>• Electrical</li> <li>--If a failure occurs in the circuitry of the sound level meter, it would be impossible to obtain accurate measurements.</li> </ul> <p>The following indication could be used to determine the failure of sound level meter:</p> <ul style="list-style-type: none"> <li>• No deflection of the pointer on the scale.</li> <li>• Repeated measurements in the same locations can be used to determine any erratic operation of the instrument.</li> </ul> <p>Reference 7.</p>
3.5.3 Specify the $P_f$ for the frequency analyzer.		0.1		IIIb	<p>The frequency analyzer is used in conjunction with the sound level meter to determine the spectral distribution of the noise within the workshop. The <math>P_f</math> for the frequency analyzer is very small. If this should fail, the following situation could occur:</p> <ul style="list-style-type: none"> <li>• Electrical</li> <li>--Refer to functional item 3.5.2.</li> </ul> <p>The following indication could be used to determine the failure of Frequency Analyzer:</p> <ul style="list-style-type: none"> <li>• Refer to functional item 3.5.2.</li> </ul> <p>Reference 7.</p>
3.5.4 Specify the $P_f$ for the surface temperature sensor. (digital type).		-0.1		IIIb	<p>The surface temperature sensor (digital type) is a direct reading electronic unit and has a sensitive probe that senses the temperature of the surface under investigation. The sensor has a range of <math>\pm 200^\circ\text{F}</math>. The unit is battery operated and the voltage of the battery is TBD.</p> <p>The <math>P_f</math> for the surface temperature sensor is very small. If it should fail, the following could occur:</p> <ul style="list-style-type: none"> <li>• Electrical</li> <li>--Failure of the electronic components could result in inconsistent temperature readouts.</li> </ul> <p>The following indication can be used to determine the failure of the temperature sensor:</p>

TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 8 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES		CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM. MAX.		
3.5.4 (Concluded)				<ul style="list-style-type: none"> <li>Inconsistent readings of the sensor could be verified by comparing the readings obtained from the second temperature sensor.</li> </ul> <p>Reference 7.</p>
3.5.5 Specify the $P_{ft}$ for the ambient thermometers.	nil		IIIb	<p>The thermometers provide the means of measuring ambient temperatures. They have a temperature range of -40 to 160 °F with an accuracy of <math>\pm 1</math> percent of full scale.</p> <p>There are two ambient thermometers provided for the experiment. In the event one of the thermometers fails, the other one can be used. These thermometers can be immersed in gaseous or liquids. The <math>P_f</math> for the thermometer is considered to be remote. If the thermometer should fail, the following situation could occur:</p> <ul style="list-style-type: none"> <li>Mechanical               <ul style="list-style-type: none"> <li>--Failure of the sensing elements of the ambient thermometer can result in faulty temperature indications.</li> </ul> </li> </ul> <p>The following indication can be used to determine the failure of the ambient thermometer.</p> <ul style="list-style-type: none"> <li>Obtain repeated readings in the same location. Any inconsistent reading could be used as an indication of a failure of the instrument.</li> </ul> <p>Reference 7.</p>
3.5.6 Specify the $P_{ft}$ for the spring scale.	nil		IIIb	<p>Spring scales are used to measure the forces required to open or close the drawers and panels. The seal is a push pull type gage that has a range of 1 to 50 lb or 1 to 25 kg, and an accuracy of 0.5 percent of full scale. The <math>P_f</math> for the spring seals is considered to be remote. If this should fail, the following situation could occur:</p> <ul style="list-style-type: none"> <li>Mechanical               <ul style="list-style-type: none"> <li>--Failure of the components such as spring or friction clutch would result in obtaining inaccurate readings.</li> </ul> </li> </ul> <p>The following indications could be used to determine the failure of the spring scale.</p> <ul style="list-style-type: none"> <li>Obtain repeated readings by pushing and pulling the scale through a constant distance. The resulting readings should be identical. If not, it is an indication of a faulty instrument.</li> </ul> <p>Reference 7.</p>

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TABLE D-1. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS PRE-FLIGHT OPERATION EVALUATION ANALYSIS (Sheet 9 of 9)

FUNCTIONAL BLOCK NUMBER AND TITLE	EXPECTED RANGE AND DIMENSION OF VARIABLES			CRITICALITY CATEGORY NUMBER	REMARKS
	MIN.	NOM.	MAX.		
3.5.7 Describe the functions of the measuring tape.				N/A	The measuring tape is 10 ft long and provides a means for measuring distances to evaluate pertinent sizes and locations.  Reference TBS.
3.5.8 Describe the functions of the batteries.					Twenty D size batteries will be provided as spares for experiment equipment. The specifications are as follows: <ul style="list-style-type: none"><li>• Nominal voltage (1.5 Vdc)</li><li>• Rated capacity (10,000 mA hr)</li><li>• Weight (5 oz)</li><li>• Volume (3.20 in<sup>3</sup>).</li></ul> Reference 7.
3.5.9 Describe the equipment container.				N/A	The equipment container is required for stowage of experiment hardware. It has three drawers and its volume in in <sup>3</sup> is 11.2 by 15.8 by 9.7.  Reference 7.
3.5.10 Describe the functions of the DAC.				N/A	The DAC is used for photographing M-487 activities. Film sequences will be recorded by using the following support equipment: <ul style="list-style-type: none"><li>• 16 mm film cassettes (3) (400 ft)</li><li>• 10mm and 5mm lenses</li><li>• Power cable, remote cable, and camera mount.</li></ul> Reference 7.
3.5.11 Describe the functions of the CO <sub>2</sub> humidity sensor.					Measures the CO <sub>2</sub> and humidity level in the OWS.  Reference 1.

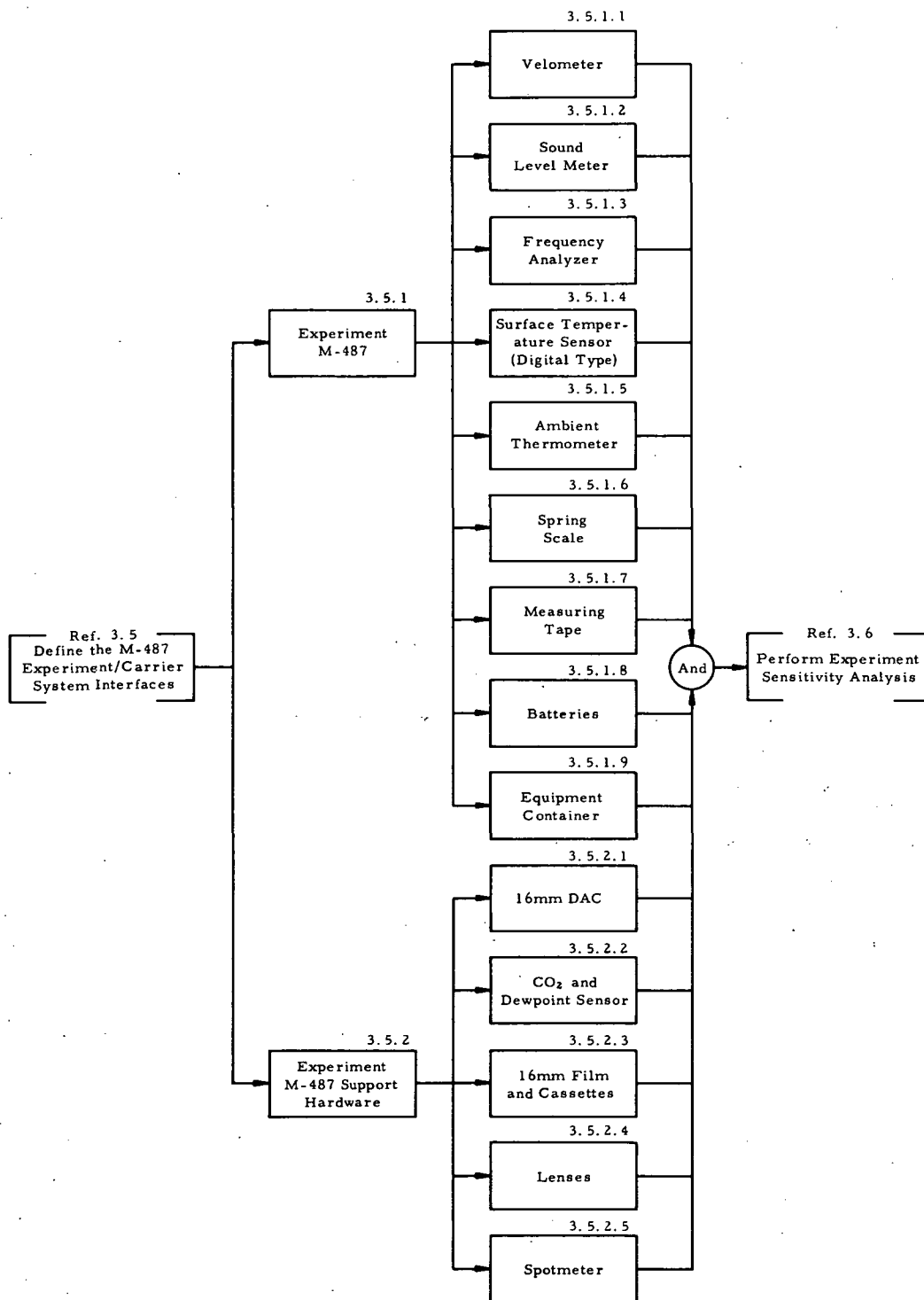
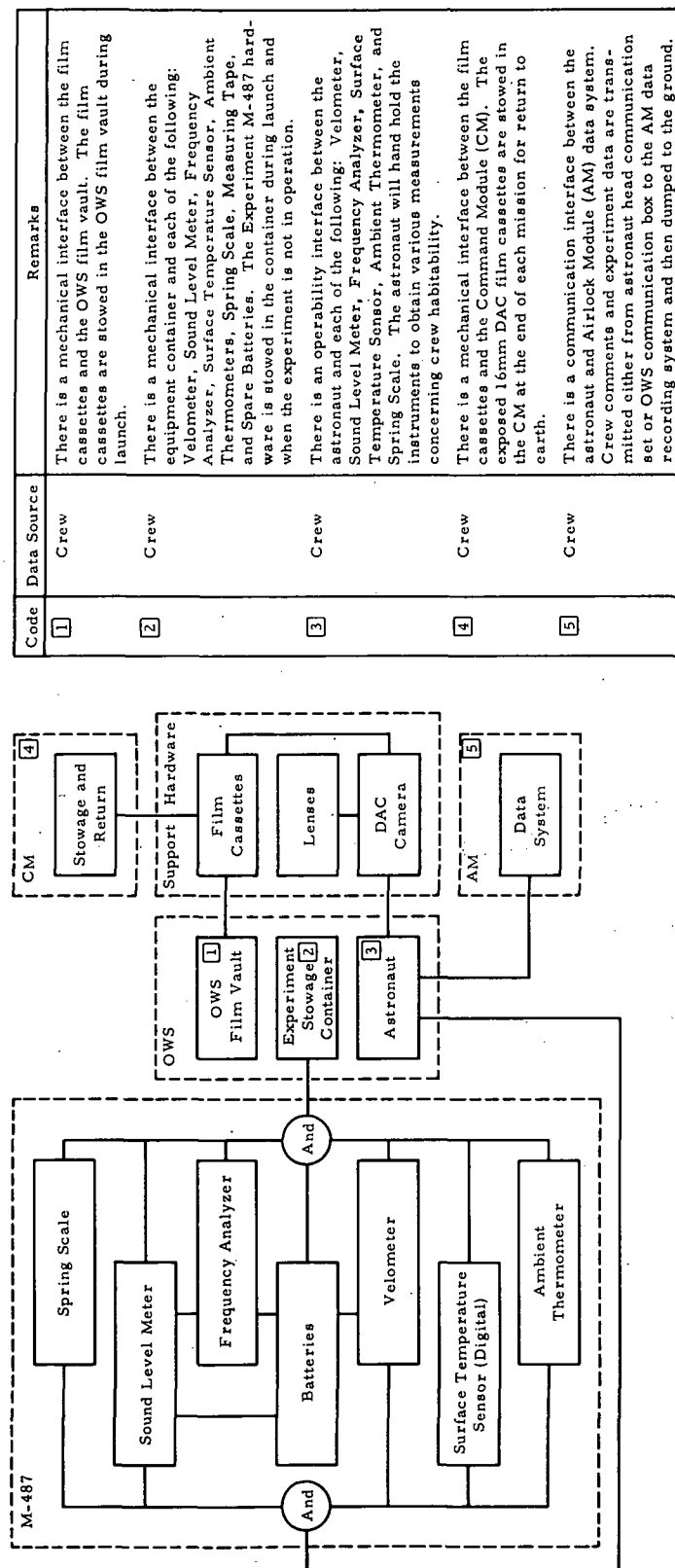


FIGURE D-1. EXPERIMENT M-487, HABITABILITY / CREW QUARTERS FUNCTIONAL BLOCK DIAGRAM

SECTION II.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
INTERFACE BLOCK DIAGRAM

FIGURE D-2. EXPERIMENT M-487, HABITABILITY / CREW QUARTERS INTERFACE BLOCK DIAGRAM AND DEFINITION



SECTION III.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
SYSTEM DIAGRAM

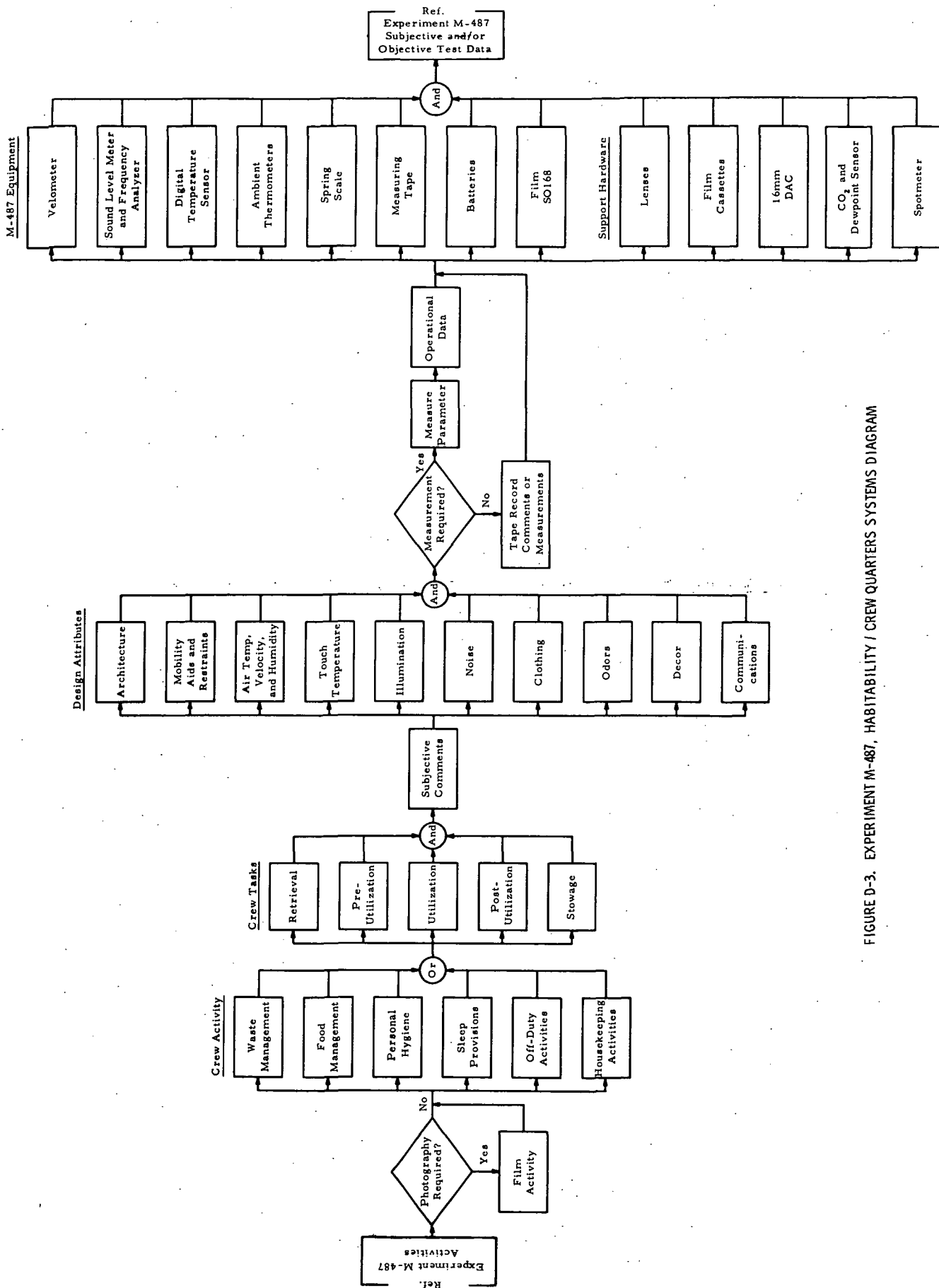


FIGURE D-3. EXPERIMENT M-487, HABITABILITY / CREW QUARTERS SYSTEMS DIAGRAM

**SECTION IV.**

**EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
DATA REQUIREMENTS SUMMARY**

TABLE D-II. EXPERIMENT M-487, HABITABILITY / CREW QUARTERS DATA REQUIREMENTS SUMMARY

Measurement Name	Range and Dimension of Variable	Measurement Number	Telemetry Assignment Channel	Data Return	Data Time	Remarks
<ul style="list-style-type: none"> <li>• Astronaut Voice Comments and Recording: <ul style="list-style-type: none"> <li>--Dimensional characteristics of OWS equipment</li> <li>--Mobility aids and restraints</li> <li>--Air Temperature</li> <li>--Air Velocity</li> <li>--Humidity</li> <li>--Touch Temperature</li> <li>--Illumination</li> <li>--Noise Levels</li> </ul> </li> <li>• Temperature, Ventilation Control System (VCS), Wardroom Inlet Gas</li> <li>• Temperature, VCS, Experiment Compartment Inlet Gas</li> <li>• Temperature, VCS, Sleep Compartment Inlet Gas</li> <li>• Temperature, VCS, Mixing Chamber (M/C) Inlet Gas</li> <li>• Temperature, Thermal Control System (TCS), Wardroom Ceiling</li> <li>• Temperature, TCS, Sleep Compartment Ceiling</li> <li>• Temperature, TCS, Experiment Compartment Ceiling</li> <li>• Temperature, TCS, Sleep Compartment Wall</li> <li>• Temperature, TCS, Wardroom Stowage Locker</li> <li>• Temperature, TCS, Wardroom Wall No. 1</li> <li>• Temperature, TCS, Experiment Compartment Ceiling</li> <li>• Logbook</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> <li>N/A</li> <li>25 to 125 °F</li> <li>0 to 100 ft/min</li> <li>TBD</li> <li>0 to 200 °F</li> <li>TBD</li> <li>30 to 140 dB</li> <li>40 to 100 °F</li> <li>40 to 100 °F</li> <li>40 to 100 °F</li> <li>40 to 100 °F</li> <li>0 to 120 °F</li> <li>0 to 120 °F</li> <li>0 to 120 °F</li> <li>0 to 120 °F</li> <li>0 to 120 °F</li> <li>0 to 120 °F</li> <li>0 to 120 °F</li> <li>0 to 120 °F</li> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>C 7144-438</li> <li>C 7255-438</li> <li>C 7256-438</li> <li>C 7254-436</li> <li>C 7123-437</li> <li>C 7032-437</li> <li>C 7122-437</li> <li>C 7094-441</li> <li>C 7033-463</li> <li>C 7059-443</li> <li>C 7040-437</li> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>WP1A150A52LO21</li> <li>WP1B104A14LB04</li> <li>WP1A050A43LM18</li> <li>WP1B104A10LB03</li> <li>WP1A150A48LQ20</li> <li>WP1A150A40LQ18</li> <li>WP1A050A23LM13</li> <li>WP1A010A35LM16</li> <li>WP1A150A32LQ16</li> <li>WP1B150A30LQ08</li> <li>WP1A150A20LQ13</li> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>Intermittent</li> <li>Intermittent</li> <li>Intermittent</li> <li>Intermittent</li> <li>Intermittent</li> <li>Intermittent</li> <li>Intermittent</li> <li>Intermittent</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>Continuous</li> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>Real/All</li> <li>Real/All</li> <li>Real/All</li> <li>Real/All</li> <li>Real/All</li> <li>Real/All</li> <li>Real/All</li> <li>Real/All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>All</li> <li>N/A</li> </ul>	



SECTION V.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
DATA REQUEST FORMS

## DATA REQUEST FORM

Skylab Program

DRF Control No.

Date

Exp/Sys No.

ASTN-SD/OWS/EXP-068

Revision

Mission

SL

Period of Interest

FLT

Op. Need Date

Rev Date

Request Contact

Data Recipient

Date Req

Name

Organization

Phone

Name

Address

Phone

Mr. W. R. Bock

S&amp;E-ASTN-SDF

MSFC, Alabama 35812

205-453-3810

Qty

Reference Documents

MRD Content

Detailed Requirements:

Experiment Crew Logs

Provide one copy of the crew logs taken during operation of experiments M487 and M516

Comments &amp; Explanations

Originator

Integrator

Name

W. R. Bock

Organization

MSFC/S&amp;E-ASTN-SDF

Phone

205-453-3810

Signature

*W. R. Bock*

Date 3-27-72

Name

J. R. Riquelmy

Organization

S&amp;E-ASTN-SDF

Phone

205-453-3810

Signature

*J. R. Riquelmy*

Date 3-27-72

Request Approval

Implementing Agency

Name

Organization

Phone

Signature

Date

Name

Organization

Phone

Signature

Date

<b>DATA REQUEST FORM</b> Skylab Program		DRF Control No.		Date
		Exp/Sys No. ASTN-SDI/OWS/M-487		Revision
Mission SL-1/SL-2 SL-3 and SL-4	Period of Interest FLT/Manned		Op. Need Date	Rev Date
Request Contact		Data Recipient		Date Req
Name		Name Mr. W. R. Bock		Real
Organization		Address S&E-ASTN-SDF		Qty
Phone		Phone MSFC, Alabama 35812 205-453-3810		
Reference Document:				
MRD Content				
<b>Detailed Requirements:</b>  The Payload Integration Section (S&E-ASTN-SDI) needs to assess the level of housekeeping data for Experiment M-487, Habitability/Crew Quarters. These data are needed 10 min before the experiment, once during midpoint, and at the end of the experiment.  A hard copy of the data should be made available to the user.				
<b>Comments &amp; Explanation:</b>  These data will be used to measure and evaluate the experiment/carrier interface so that Skylab Mission evaluation reporting requirements can be fulfilled. (See OMSF Program Directive 55 M-D ML, 138, 5-71).				
<b>Originator</b>		<b>Integrator</b>		
Name K. S. Purushotham		Name J. R. Riquelmy		
Organization Teledyne Brown Engineering		Organization S&E-ASTN-SDF		
Phone 532-1612		Phone 205-453-3810		
Signature _____		Signature _____		
Date _____		Date _____		
<b>Request Approval</b>		<b>Implementing Agency</b>		
Name _____		Name _____		
Organization _____		Organization _____		
Phone _____		Phone _____		
Signature _____		Signature _____		
Date _____		Date _____		

DRF Control No.	Exp/Sys No. ASTN-SDI/OWS/M-487	Revision	Date
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## Detailed Requirements:

Measurement No.	Measurement Name
C 7144-438	Temp, VCS, Wardroom Inlet Gas
C 7255-438	Temp, VCS, Experiment Compartment Inlet Gas
C 7256-438	Temp, VCS, Sleep Compartment Inlet Gas
C 7254-438	Temp, VCS, M/C Inlet Gas
C 7123-437	Temp, TCS, Wardroom Ceiling
C 7032-437	Temp, TCS, Sleep Compartment Ceiling
C 7122-437	Temp, TCS, Experiment Compartment Ceiling
C 7094-441	Temp, TCS, Sleep Compartment Wall
C 7033-443	Temp, TCS, Wardroom Stowage Locker
C 7059-443	Temp, TCS, Wardroom Wall No. 1
C 7040-437	Experiment Compartment Ceiling No. 2

SECTION VI.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
ENGINEERING CHANGE REQUESTS

Engineering Change Requests for Experiment M-487 are N/A.

SECTION VII.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
EVALUATION SEQUENCE

TABLE D-III. EXPERIMENT M-487, HABITABILITY / CREW QUARTERS EVALUATION SEQUENCE (Sheet 1 of 9)

<u>Assignments</u>		<u>Conditions</u>	<u>Requirements</u>
Mission:	• SL-1/SL-2, SL-3, and SL-4	Crew:	• Any crewmen can perform the experiment
Orbital Assembly:	• OWS	Experiment:	• Experiments M-172, M-092, M-171, and ATM are operating during M-487 experiment.
Carrier:	• The experiment hardware is stowed in Wardroom Locker W749. The locker is located between Positions II and III at OWS Sta. No. 409. 562 (approximate).	Ground Support:	• Prelaunch: N/A • Post-launch: N/A
<u>Experiment Evaluation Team - Key Personnel Locator</u>			
<u>Name</u>	<u>Responsibility</u>	<u>Office Address, Symbol, and Telephone Number</u>	
Mr. C. C. Johnson	Principal Investigator (PI)	MSC, Houston, Texas, 713-483-3491	
Mr. Gaylord Huffman	Experiment Developer (ED)	MSFC, Bldg. 4201, PM-SL-SW, 205-453-0820	
Mr. Robert Bond	Experiment Developer (ED)	MSC, Houston, Texas, 713-483-3491	
Mr. Gaylord Huffman	MSFC Experiment Manager (EM)	MSFC, Bldg. 4201, PM-SL-SW, 205-453-0820	
Mr. Jack Stokes	S&E Integration Engineer (IE)	MSFC, Bldg. 4610, S&E-ASTN-SMH, 205-453-3793	
Mr. W. R. Bock	Technical Discipline Manager (TDM)	MSFC, Bldg. 4610, S&E-ASTN-SDF, 205-453-3810	
Mr. K. S. Purushotham	Experiment Operation Engineer (EOE)	Teledyne Brown Engineering Company, Huntsville, Alabama, 205-532-1612	
Mr. Charles Evans	Experiment Integration Engineer (EIE)	MMC, Denver, Colorado, 303-794-5211, ext. 2094	
Mr. John L. Nelson	Experiment Flight Controller (EFC)	MSC, Houston, Texas, Bldg. 30FC-4, 713-453-4717	

Experiment Evaluation Team - Key Personnel Locator

<u>Name</u>	<u>Responsibility</u>	<u>Office Address, Symbol, and Telephone Number</u>
Mr. C. C. Johnson	Principal Investigator (PI)	MSC, Houston, Texas, 713-483-3491
Mr. Gaylord Huffman	Experiment Developer (ED)	MSFC, Bldg. 4201, PM-SL-SW, 205-453-0820
Mr. Robert Bond	Experiment Developer (ED)	MSC, Houston, Texas, 713-483-3491
Mr. Gaylord Huffman	MSFC Experiment Manager (EM)	MSFC, Bldg. 4201, PM-SL-SW, 205-453-0820
Mr. Jack Stokes	S&E Integration Engineer (IE)	MSFC, Bldg. 4610, S&E-ASTN-SMH, 205-453-3793
Mr. W. R. Bock	Technical Discipline Manager (TDM)	MSFC, Bldg. 4610, S&E-ASTN-SDF, 205-453-3810
Mr. K. S. Purushotham	Experiment Operation Engineer (EOE)	Teledyne Brown Engineering Company, Huntsville, Alabama, 205-532-1612
Mr. Charles Evans	Experiment Integration Engineer (EIE)	MMC, Denver, Colorado, 303-794-5211, ext. 2094
Mr. John L. Nelson	Experiment Flight Controller (EFC)	MSC, Houston, Texas, Bldg. 30FC-4, 713-453-4717



TABLE D-III. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 2 of 9)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satisfactory	Anomally		
P - 60 min GMT 12:00 for SL-1/SL-2; GMT 13:30 for SL-3; GMT TBD for SL-4.  P - 10 min GMT 12:50 for SL-1/SL-2; GMT 14:20 for SL-3; GMT TBD for SL-4.	Experiment Evaluation Team manned and available. Contact Experiment M-487 Technical Discipline Manager, S&E-ASTN-SD: HOSC Telephone No.: TBD, Astronautics Laboratory Telephone No. 205-453-3810. Reference: Skylab Flight Plan, SL-1/SL-2, SL-3, and SL-4, MSC No. TBD, Latest revision, May 2, 1972.  Commence experiment preparation (ground action).					

\*P - Preparation  
O - Operations  
T - Termination  
L - Lift-off (Booster)

\*\*TP - Test Pilot (Commander)  
OBS - Observer (Science Pilot)  
PLT - Pilot  
ALL - TP/OBS/PLT

TABLE D-III. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 3 of 9)

Operation Step Number	Data										Contingencies	
	Recorder Number	Measurement Name, Number, and Signal	Return			Range and Dimension of Variables				Evaluation		Remarks
			Telemetry Channel	Function**	Frequency***	Range and Dimension of Variables	Satisfactory	Anomaly	Check			
P 1.0												
P 1.1												
		Determine experiment status.										
		Acquire status and evaluate performance of the following measurements:										
	TBS	Temperature, VCS, Wardroom Inlet gas C 7144-438	WPIA150A52LO21	H C	Range: 40 to 100 °F Read: 65 to 80 °F							
	TBS	Temperature, VCS, Experiment Compartment Inlet gas C 7255-438	WP1B104A14LB04	H C	Range: 40 to 100 °F Read: 65 to 80 °F							
	TBS	Temperature, VCS, Sleep Compartment Inlet gas C 7256-438	WPIA050A43LM18	H C	Range: 40 to 100 °F Read: 65 to 80 °F							
	TBS	Temperature, VCS, Mixing Chamber Inlet gas C 7254-436	WP1B104A10LB03	H C	Range: 40 to 100 °F Read: 65 to 80 °F							
* P - Preparation O - Operations T - Termination L - Lift-off (Booster) ASTN-72-1-OT (Jan 72)												
** E - Event H - Housekeeping A - Analog D - Digital												
*** C - Continuous I - Intermittent D - Discrete (Specified number of times)												
**** R - Real Time N - Near/Real Time A - All Time												

TABLE D-III. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 4 of 9)

Operation Step Number#		Data										Contingencies	
		Return					Evaluation						
		Recorder Number	Measurement Name, Number, and Signal	Telemetry Assignment Channel	Function#	Frequency**	Range and Dimension of Variables	Limits of Concern	Satisfactory Anomaly Check	Remarks***	See Contingency Plan Number		
P 1.1 (Continued)	TBS	Temperature, TCS, Wardroom Ceiling C 7123-437	WPIA150A48LQ20	H	C	Range: 0 to 120 °F Read: 65 to 85 °F							
	TBS	Temperature, TCS, Sleep Compartment Ceiling C 7032-437	WPIA150A40LQ18	H	C	Range: 0 to 120 °F Read: 65 to 85 °F							
	TBS	Temperature, TCS, Experiment Compartment Ceiling C 7122-437	WPIA050A23LM13	H	C	Range: 0 to 120 °F Read: 65 to 85 °F							
	TBS	Temperature, TCS, Sleep Compartment Wall C 7094-441	WPIA010A35LM16	H	C	Range: 0 to 120 °F Read: 65 to 85 °F							
	TBS	Temperature, TCS, Wardroom Storage Locker C 7033-443	WPIA150A32LQ16	H	C	Range: 0 to 120 °F Read: 65 to 85 °F							

\*\* P - Preparation  
 O - Operations  
 T - Termination  
 L - Lift-off (Booster)  
 \*\*\* E - Event  
 H - Housekeeping  
 A - Analog  
 D - Digital  
 \*\*\*\* R - Real Time  
 N - Near/Real Time  
 A - All Time  
 C - Continuous  
 I - Intermittent  
 D - Discrete  
 (Specified number of times)

ASTN-72-1-OT (Jan 72)

TABLE D-III. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 5 of 9)

Data														Contingencies	
Return				Evaluation											
Operation Step Number*	Recorder Number	Measurement Name, Number, and Signal	Telemetry Assignment Channel	Function#	Frequency**	Range and Dimension of Variables	Limits of Concern	Satisfactory	Check Anomaly	Remarks***	See Contingency Plan Number	Remarks			
P 1.1 (Concluded)	TBS	Temperature, TCS, Wardroom Wall No. 1 C 7059-443	WP1B150A30LQ08	H	C	Range: 0 to 120 °F  Read: 65 to 85 °F									
	TBS	Temperature, TCS, Experiment Compartment Ceiling C 7040-437	WP1A150A20LQ13	H	C	Range: 0 to 120 °F  Read: 65 to 85 °F									
	TBS	Voltage: Power Distribution Control System (PDCS) OWS Bus No. 1 M 7002-440	WP1B050A21LH05	H	C	Range: 0 to 35 Vdc  Read: 24 to 30 Vdc									
	TBS	Voltage: PDCS, OWS Bus No. 2 M 7003-440	WP1B010A21LH05	H	C	Range: 0 to 35 Vdc  Read: 24 to 35 Vdc									

\* P - Preparation  
 O - Operations  
 T - Termination  
 L - Lift-off (Booster)  
 \*\* E - Event  
 H - Housekeeping  
 A - Analog  
 D - Digital  
 \*\*\* C - Continuous  
 I - Intermittent  
 D - Discrete  
 (Specified number of times)  
 R - Real Time  
 N - Near/Real Time  
 A - All Time

ASTN-72-1-OT (Jan 72)

TABLE D-III. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 6 of 9)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satisfactory	Anomalous		
P = 0 min GMT 13:00 for SL-1/SL-2; GMT 14:30 for SL-3; GMT TBD for SL-4.		Commence experiment preparation (flight action).				
P 2.0	PLT/ANY	Conduct Velometer Calibration Checkout.				
P 2.1		Remove the velometer and probe from the stowage container.				
P 2.1.1		Plug the probe into the connector at the front of the instrument.				
P 2.1.2		Cap the probe with a rubber cap and hold the probe in a vertical position with the cable hanging down.				
P 2.1.3		Press and hold the ON-OFF switch.				
P 2.1.4		Calibrate the velometer indicator to read zero velocity.			P214A1 P214B1	
P 2.2	PLT/ANY	Conduct sound level meter and frequency analyzer checkout.				
P 2.2.1		Remove the sound level meter and frequency analyzer pan from the stowage container and perform battery check.				
P 2.2.1.1		Pull out KNOB 1 and set to position BATT.				
P 2.2.1.2		Verify the meter pointer.				
P 2.2.2	PLT/ANY	Check the amplifier and the meter circuit.			P2212A1 P222A1	Should deflect within the area marked "Battery"
P 2.2.2.1		Set KNOB 1 to position LIN and turn KNOB 3 fully clockwise.				

\*P - Preparation  
O - Operations  
T - Termination  
L - Lift-off (Booster)

\*\*TP - Test Pilot (Commander)  
ORS - Observer (Science Pilot)  
PLT - Pilot  
ALL - TP/ORS/PLT

TABLE D-III. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 7 of 9)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satisfactory	Anomalous		
P 2.2.2.2		Turn KNOB 2 fully counter clockwise until REF mark appears in the red circle to the right.				
P 2.2.2.3		Verify the meter pointer on the upper red scale (should be equal to the K value of the microphone).				
P 2.3	PLT/ANY	Remove the digital thermometer and probe from the stowage container.				
P 2.3.1		Install the probe on the thermometer and prepare for operation.				
O 1.0	PLT/ANY	Commence experiment operation.				
O 1.1		Velometer Operation.				
O 1.1.1		Remove the cap from the probe.				
O 1.1.2		Hold the probe in the air stream where it is required to obtain a measurement of air velocity. (The probe must be held in such a way that any movement should be perpendicular to the open end of the probe).				
O 1.1.3		Press the ON-OFF switch downwards and obtain readings.			0112A1	Repeat the experiment as many times as necessary to obtain an average reading.
O 1.1.4		Voice record both subjective and objective comments about the readings.				
O 1.2		Sound Level Meter and Frequency Analyzer Operation.				
O 1.2.1		Sound Measurement:				
O 1.2.1.1		Pull out KNOB 1.				
O 1.2.1.2		Set KNOB to position LIN.				
O 1.2.1.3		Rotate KNOB 2 clockwise until meter deflection reads between 0 and 10 dB.			01213A1	

\*P - Preparation  
O - Operations  
T - Termination  
L - Lift-off (Booster)

\*\*TP - Test Pilot (Commander)  
OBS - Observer (Science Pilot)  
PLT - Pilot  
ALL - TP/OBS/PLT

MFPC - One Time Form 17-1 (March 1972)

TABLE D-111. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 8 of 9)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satisfactory	Anomally		
O 1.2.1.4		Set KNOB 1 to the desired position.				
O 1.2.1.5		Rotate KNOB 3 (if necessary) counter clockwise to obtain a deflection between 0 and 10 dB (do not use KNOB 2 at this stage. KNOB 2 will overdrive the input amplifier).				
O 1.2.1.6		Obtain the reading on the meter together with value shown in the red circle.				
O 1.2.2		Frequency Measurement:				
O 1.2.2.1		Calibrate the instrument using Operation Step Nos. P 2.2.1.1 through P 2.2.2.3.				
O 1.2.2.2		Repeat Operation Step Nos. O 1.2.1.1 through O 1.2.1.3.				
O 1.2.2.3		Set KNOB 1 to EXT FILT.				
O 1.2.2.4		Repeat Operation Step No. O 1.2.1.6.				
O 1.3		Voice record subjective and objective comments about the measurements.				
O 1.3.1		Digital Temperature Sensor Operation.				
O 1.3.2		Place the probe on the measurement surface.				
O 1.3.3		Set the temperature range switch to the desired position.				
O 1.3.4		Push the readout switch and observe the digital display.				
		Voice record both subjective and objective comments of the measurement.			O133A1	
		Note: M-487 experiment measurements are conducted in the following areas:				

\*P - Preparation  
O - Operations  
T - Termination  
L - Lift-off (Booster)

\*\*TP - Test Pilot (Commander)  
OBS - Observer (Science Pilot)  
PLT - Pilot  
ALL - TP/OBS/PLT

TABLE D-III. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS EVALUATION SEQUENCE (Sheet 9 of 9)

Operation Step Number*	Crewman**	Test Procedure	Evaluation (Check One)		See Contingency Plan Number	Remarks
			Satisfactory	Anomaly		
O 1.3.4 (Concluded)		<ul style="list-style-type: none"> <li>• Sleep compartment</li> <li>• Wardroom</li> <li>• Waste management</li> <li>• Experiment compartment</li> <li>• Forward compartment.</li> </ul>				
T 1.0		Terminate the Velometer Operation.				
T 1.1		Release the ON-OFF switch.				
T 1.1.1		Install the cap on the probe.				
T 1.1.2		Remove the probe from the instrument.				
T 1.1.3		Stow the instrument and probe in the stowage container.				
T 1.2		Terminate sound level meter and frequency analyzer operation.				
T 1.2.1		Push KNOB 1 to turn the POWER OFF.				
T 1.2.2		Return KNOBS 2 and 3 to the original position.				
T 1.2.3		Stow the sound level meter and frequency analyzer.				
T 1.3		Terminate digital temperature sensor.				
T 1.3.1		Turn power switch off.				
T 1.3.2		Remove the sensing probe.				
T 1.3.3		Stow digital temperature sensor and probe in the stowage container.				

\*P - Preparation  
O - Operations  
T - Termination  
L - Lift-off (Booster)

\*\*TP - Test Pilot (Commander)  
OBS - Observer (Science Pilot)  
PLT - Pilot  
ALL - TP/OBS/PLT

MSFC - One Time Form 174 (March 1972)



SECTION VIII.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
MALFUNCTION AND CONTINGENCY PLAN OUTLINE

TABLE D-IV. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT PREPARATION (P)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
P 2.1.4	Calibrate the velometer to make the indicator read zero velocity.	P214A The velometer indicator does not deflect. P214B Velometer cannot be calibrated.	P214A1 Replace the battery. P214A2 Continue the experiment. P2124B1 Continue the experiment in degraded mode.	Probable cause is a weak battery.
P 2.2.1.2	Verify the meter pointer.	P2212A The meter does not deflect.	P2212A1 Replace the battery. P2212A2 Continue the experiment.	Suspect weak battery.
P 2.2.2	Check the amplifier circuit.	P222A The pointer does not move. Probable failure in the electronic circuitry.	P222A1 Terminate the use of sound level meter; partial loss of experiment.	

P

ASTN-OT-7 (Feb. 72)

TABLE D-V. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT OPERATION (O)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
O 1.1.2	Press the ON-OFF switch downwards and obtain readings.	O112A No indication on the meter. Thermocouple elements are broken.	O112A1 Terminate the experiment.	
O 1.2.1.3	Rotate KNOB 2 clockwise until the meter deflection reads between 0 and 10 dB.	O1213A Erratic indication; probably a defective switch.	O1213A1 Recycle the switch. If no change in state, terminate the experiment.	
O 1.3.3	Push the readout switch and observe digital display.	O133A No digital display.	O133A1 Use the other surface temperature sensor (digital type) and continue the experiment.	

O

TABLE D-VI. EXPERIMENT M-487, HABITABILITY/CREW QUARTERS MALFUNCTION AND CONTINGENCY PLAN OUTLINE - EXPERIMENT TERMINATION (T)

Operation Step Number	Experiment/Crew Tasks	Possible Malfunction	Contingency Plan	Remarks (malfunctions, corrections, results)
	No contingency plans are identified for the Termination Section of this experiment at this time.			

T

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SECTION IX.

EXPERIMENT M-487, HABITABILITY/CREW QUARTERS  
MALFUNCTION ANALYSIS

The material contained in this section is an excerpt from Reference 8.

## 17. Habitability/Crew Quarters, M487

The objective of Experiment 487 is to accumulate engineering data concerning the habitability features of the OWS for use in the design of future manned spacecraft. The functions to be performed in achieving this objective are of a minor nature and entail only a minimal malfunction analysis. Typical of the problem that might be encountered is the restoration of an instrument, e.g., the velometer, to a useful state by replacing its batteries.

Table 17.1 Operational Functions and Malfunction Analysis Items, M487

Operational Function	Malfunction Analysis Item
17.1 Provide Air Flow Measurement	17.1.1 Velometer Fails
17.2 Provide Noise Meas. Capability/Frequency Analysis	17.2.1 Sound Pressure Level Meter Fails
17.3 Provide Surface Temperature Sensing Capability	17.3.2 Digital Thermometer Fails

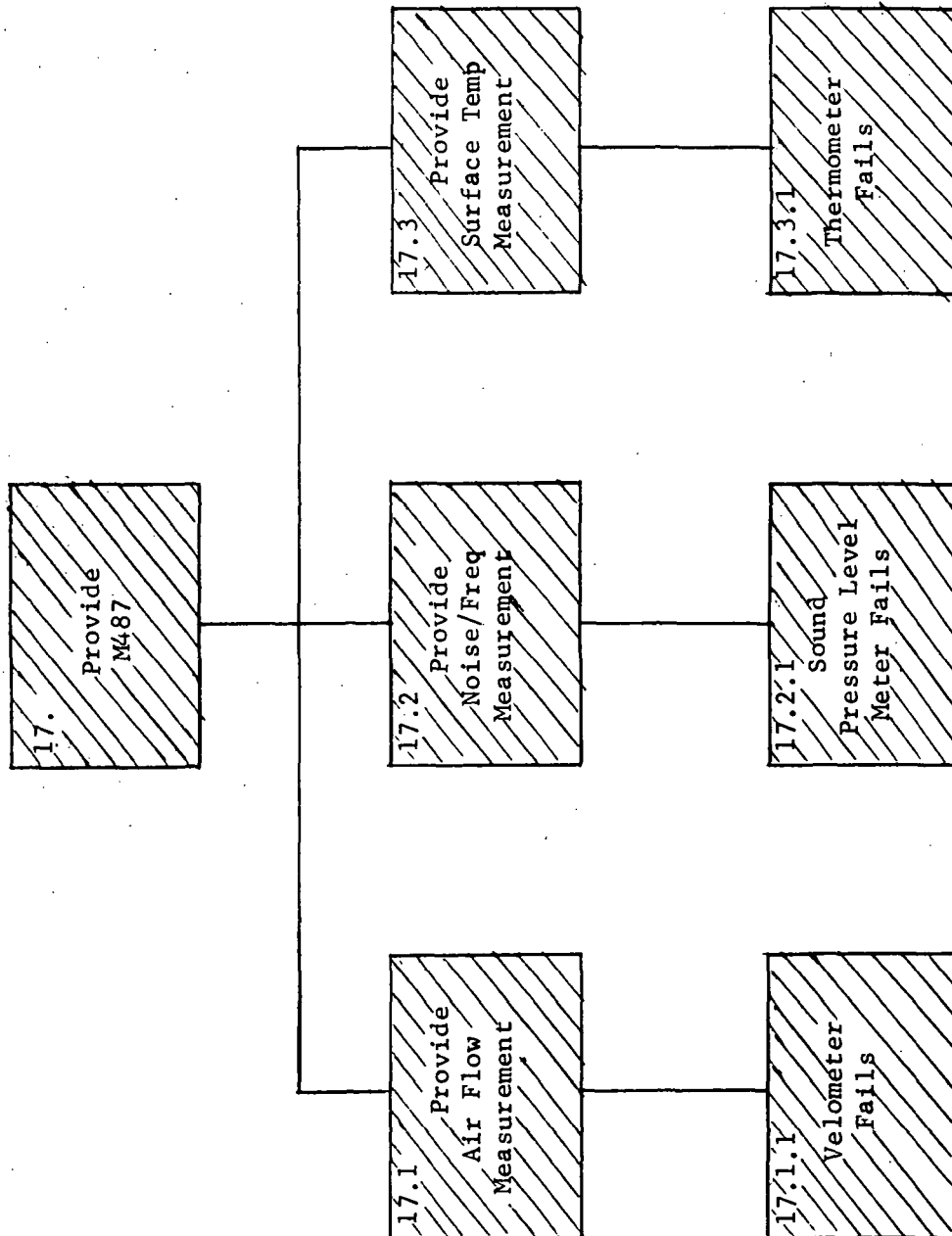


Figure 17.1 Functional Flow and Malfunction Analysis  
Diagram, Experiment M487

MALFUNCTION ANALYSIS CHART, M487

MALFUNCTION	INDICATION			EFFECT			ACTION
	PRIMARY MEASUREMENTS	SUPPORT MEASUREMENTS	MISSION/CREW	SYSTEM/SUBSYSTEM	SYSTEM/ INTERACTION		
17. Provide M487							
17.1 Provide Air Flow Measurement							
17.1.1 Air Flow Meter Failure (Sensor, Circuit or Battery)	Crew Observation (U): Meter reads zero or exhibits erratic behavior.	None	Mission: None Crew: Experiment timeline revision.	Air flow data not available.	None	Ground Action: None Crew Action: Phases D, F & H 1. Replace batteries, or 2. Replace probe and/or entire unit on next visitation.	
17.2 Provide Noise Measurement Capability and Frequency Analysis							
17.2.1 Sound Pressure Level Meter Failure (Microphone, Circuit, Octave Filter Set or Battery)	Crew Observation (U): Meter reads zero or exhibits erratic behavior.	None	Mission: None Crew: Exp timeline revision.	Noise data not available.	None	Ground Action: None Crew Action: Phases D, F & H 1. Replace batteries, or 2. Replace microphone and/or entire unit on next visitation.	
17.3 Provide Surface Temperature Sensing Capability							
17.3.1 Digital Thermometer Failure	Crew Observation (U): Meter reads zero or exhibits erratic behavior.	None	Mission: None Crew: Exp timeline revision.	Surface temperature data not available.	None	Ground Action: None Crew Action: Phases D, F & H. 1. Replace batteries, or 2. Replace sensor and/or entire unit on next visitation.	

MISSION PHASES: A. All Phases  
B. Boost to Orbit  
C. Activation  
D. 1st Visitation  
E. 1st Storage  
F. 2nd Visitation  
G. 2nd Storage  
H. 3rd Visitation



## SECTION X. CONCLUSIONS AND RECOMMENDATIONS

1. The measurement equipment used in Experiment M-487 is considered off-the-shelf items. Minimum modification has been made to some of the equipment so that it can be prepared for flight application. An analysis of the measurement devices indicates that the hardware is relatively simple and has a minimum chance of failure. If a failure should occur, it would result in a Category III failure. Based on our knowledge of the experiment, it is difficult to determine how the objective and subjective data are to be evaluated and used in meeting the objectives of the experiment. We have been unable to determine how the Principal Investigator (PI) intends to use the design and performance data in evaluation of the M-487 experiment and the application of these data for future spacecraft design.
2. A Systems Diagram (Figure D-3) has been devised and depicts how crew activities, tasks, and attitudes are related to their living quarters and environment. Tangible and intangible design attributes of the crew's living and work areas are to be considered. The crew activity consists of:
  - Waste Management
  - Food Management
  - Personal Hygiene
  - Sleep Provisions
  - Off-Duty Activities
  - Housekeeping Activities.

The crew will select all or any one of the following tasks with respect to the above activities. The tasks are:

- Retrieval
- Preutilization
- Utilization
- Post-utilization
- Stowage.

The crew will make subjective comments related to the above activities and tasks by using the following parameters:

- Architecture
- Mobility Aids and Restraints
- Air Temperature, Velocities, and Humidity
- Touch Temperature
- Illumination
- Noise
- Clothing
- Odors
- Decor
- Communication.

To evaluate the above parameters, certain portable measuring instruments are provided and will be used where applicable:

- Velometer
- Sound Level Meter and Frequency Analyzer
- Digital Temperature Sensor
- Ambient Thermometers
- Measuring Tape
- Spring Scale.

Additional supportive equipment, e. g., DAC, camera, film cassettes, lenses, spotmeter, and CO<sub>2</sub> dewpoint monitors, are used in the performance of Experiment M-487.

## REFERENCES

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